

REMARKS/ARGUMENTS

Favorable reconsideration of the present application is respectfully requested.

Claims 1-3, 5, 6, 8, 9, 21, 23-24, 26 and 27 have been canceled. New Claim 29 incorporates the subject matter of canceled Claims 1-3 but is limited to a "further portion" which comprises at least two curved portions. Claim 29 also replaces the recitation of a "cut back portion" with a recitation of a position where the plurality of splines and plurality of grooves of the splined portion diametrically converge. The basis for this is evident from the figures. The specification has similarly been amended to clarify that the position where the splines and grooves of the splined portion diametrically converge is the cut back portion 14b that extends continuously with the second curved portion 13b, as is evident from Figure 2.

The claimed invention is directed to a shaft including a shank having a large diameter portion and a splined portion engaged with a fitting member, for example as is shown in the non-limiting embodiment of Figure 1. Conventionally, a high tensile stress has been found to be present in the region where the splines and grooves of the splined portion converge (Figure 7). Prior efforts to reduce such tensile stresses, e.g., in JP 09-042303, have weakened the shank and so have not been entirely satisfactory. For example, in Figure 2 of JP '303 the shank diameter is reduced to " $d_0$ " which is smaller than the diameter  $d_1$  of the spline grooves, and in Figure 6 of the reference the diameter  $d_0$  is no greater than that at the position where the splines and grooves of the splined portion diametrically converge.

According to a feature of the claimed invention, on the other hand, the tapered portion of the shank which stops the fitting member and is located adjacent the large diameter portion of the shank only reduces the diameter of the shank to a minimum diameter greater than that of the splined portion at the position where the splines and grooves diametrically converge. For example, referring to the non-limiting elected embodiment of Figure 4, the tapered portion 12 terminates with a minimum diameter  $d_0$  which is greater than that at the position of

the cut back portion 14b where the groove portion 14a and the splined portion 14c diametrically converge. Further diameter reduction to that of the cut back portion is instead provided in Fig. 4 by the curved portion 33b in a further portion in the space between the splined portion 14 and the tapered portion 12. Other arrangements of curved and straight portions located in the further portion in the space between the splined portion and the tapered portion are possible (for example, as shown in Figures 2, 3, 5 and 6). In each case, however, the tapered portion only reduces the diameter of the shank to a minimum diameter greater than that of the cut back portion, and so the strength of the shank is enhanced. Nonetheless, the tensile stress concentration of the prior art is reduced, as evident from Figure 8b.

These features are now clearly recited in the sole independent Claim 29 which recites that the tapered portion "reduces the diameter of the shank from that of the minimum diameter of the tapered portion to that of the splined portion at the position where the plurality of splines and the plurality of grooves diametrically converge," i.e., the cut back portion 14b, and further recites that a further portion in the space between the splined portion and the tapered portion reduces the diameter of the shank from that of the tapered portion to that of the splined portion at the position where the plurality of splines and the plurality of grooves diametrically converge. These features are not taught by any of the cited prior art.

More specifically, the Examiner has rejected Claims 1-6 and 20-24 as being anticipated by the prior art of Figures 10 and 11 in the present specification. However, as is evident from Figures 10 and 11, the tapered portion 102a and the curved portion 102b in Fig. 10(b) only reduce the diameter of the shank to that of the position P1 where the plurality of splines and the plurality of grooves of the splined portion diametrically converge – the minimum diameter is not *greater than* that of the splined portion at the position where the plurality of splines and the plurality of grooves diametrically converge. Similarly, Claims 1,

4 and 22 were rejected under 35 U.S.C. § 102 as being anticipated by JP '303. However, the taper having the radius R2 in Figure 2 of JP '303 reduces the diameter of the shank to *less than* that of the splined grooves, and the corresponding portion of Figure 6 of this reference reduces the diameter of the shank to be *the same as* that of the splined portion, i.e., the same as in Figure 11 of the admitted prior art. In no case does the cited prior art teach or suggest that the tapered portion which stops the fitting member and is located adjacent the large diameter portion reduces the minimum diameter of the shank to a diameter *greater than* that of the splined portion, and that at least two curved portions in the space between the splined portion and the tapered portion further reduce the diameter of the shank to that of the splined portion. Claim 29 and its dependent claims therefore clearly define over the cited prior art.

In this regard, it is noted that patentable Claim 29 is generic to the species of the non-elected Claims 7 and 25, and so it is respectfully requested that these claims be included in any patent issuing from the present application.

Applicants are submitting replacement sheets of figures responsive to paragraphs 3 and 4 of the Office Action. The specification has been revised responsive to paragraph 6 of the Office Action, except that it is noted that, with respect to objection 6c, the diameter of the conventional groove portion is indicated in Figure 2 by the reference "H".

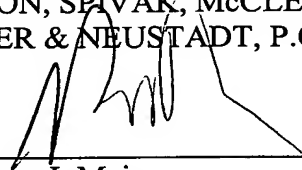
In response to the rejection under 35 U.S.C. § 112, first and second paragraphs, it is noted that Claim 1 has been canceled and that Claim 29, consistent with the specification, recites a tapered portion and a further portion in the space between the splined portion and the tapered portion, which further portion consists of at least one curved portion, at least one straight portion, and a combination of at least one curved portion combined with at least one straight portion.

Application No. 10/673,155  
Reply to Office Action of January 31, 2005

Applicants therefore believe that the present application is in a condition for allowance and respectfully solicit an early Notice of Allowability.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,  
MAIER & NEUSTADT, P.C.



Customer Number

**22850**

Tel: (703) 413-3000  
Fax: (703) 413 -2220  
(OSMMN 06/04)  
RTP:smi

ATTY\RTP\243317US-AM APR '05.DOC

---

Gregory J. Maier  
Registration No. 25,599  
Robert T. Pous  
Registration No. 29,099  
Attorneys of Record

IN THE DRAWINGS

Please replace the two sheets of drawings containing Figs. 3-6 with the attached replacement sheets wherein the reference numeral 10 in Figs. 3-6 has respectively been changed to 10', 10", 10''' and 10'''''. Also, please replace the sheet of drawings containing Fig. 7 with the attached replacement sheet in which Fig. 7 is labeled "Prior Art."

Attachment: Replacement Sheets (3)